

Application No: 09/439,416
Filing Date: November 13, 1999
Group Art Unit: 2743
Examiner: D. Harvey
Atty. Docket No: 102316-3

REMARKS

Independent claims 1 and 12 are amended herein to more clearly recite and better protect the invention. The amendment more clearly sets forth the structure of the invention, which includes a plurality of wire coils - two or more - connected directly in parallel to form the voice coil of a magnetic speaker. This is quite different from the structure of the cited reference (discussed below), in which a parallel but alternative assembly includes a second coil placed in series with a tuning circuit to provide an alternative driver operative in a narrow resonant band.

It will be understood that a loudspeaker motor relies on a stationary permanent magnet arranged such that the voice coil resides in a gap where a high magnetic field strength is focused. The voice coil is typically mounted to or carried by the diaphragm or cone of the speaker. The weight of the coil thus affects the mass and the resonance of the speaker; its dimensions are tailored to the achievable height and width of the gap (hence the magnetic field strength in the gap and overall field utilization), while the electrical characteristics (determined by size- and weight- related factors such as wire gauge, number of turns and length) determine its electrical drive current capacity and other force- or performance-related properties. Thus, a great number of competing factors effect how much coil can be used without requiring a larger, lower flux gap or introducing excessive mass or other changes adversely affecting speaker performance or cost.

Applicant realized that by layering multiple wire windings about each other and connecting them directly in parallel, it was possible to achieve enhanced utilization of the magnetic gap to efficiently drive a speaker. As explained in the Disclosure, at the bottom of page 7 and top of page 8, by using this construction a two layer directly parallel voice coil construction (as compared to a conventional two-layer single wire coil), achieves one-quarter the

resistance, hence four times the current in the same space. As compared to flat-wire winding (a conventional approach to increasing drive current) the parallel-coil arrangement may eliminate the wasted gap space of a return wire, and may have lower mass. As compared to a single-wire winding, the BxLxI product may be increased over 40% with no change of diaphragm mass, enhancing drive power and field utilization. Even greater current capacity, lower voltage operation or lesser height constructions may be achieved with more than two layers.

The Office Action had cited the Watkins '216 patent against the originally-filed claims. Watkins shows two "parallel" voice coils. However, these coils are not directly in parallel as claimed by applicant. Watkins '216 addresses an entirely different problem, namely the occurrence of excessive back-inductance at the low frequency resonance of a speaker, with the consequent loss of drive efficiency at that low and narrow frequency region. Watkins does not propose placing two coils *directly in parallel* as now claimed by applicant. Instead he proposes placing a *first* (existing) coil in parallel with a *combined structure* consisting of a *resonant circuit and an additional coil* (see Watkins Figure 2). In other embodiments, even the existing coil also has a further circuit connected in series with it, so that the pair of structures, each consisting of a *coil in series with a circuit*, are connected in parallel (see Watkins Figures 3 and 4).

I
↙

The mode of operation of the Watkins constructions is entirely different. As described at column 2, lines 29-40 of the '216 patent, the second coil of Watkins presents a low-impedance pathway at the speaker's low frequency resonance, but is ineffective off-resonance. Similarly, the first, or conventional winding, has high back-inductance in that band, and is essentially non-conducting when the other coil is operating. By adjusting the tuning parameters, the response of one coil that operates near resonance can be matched to the level of actuation that is effected by the other coil outside of resonance, so the two coils patch together an overall frequency response

Application No: 09/439,416
Filing Date: November 13, 1999
Group Art Unit: 2743
Examiner: D. Harvey
Atty. Docket No: 102316-3

that is uniform over the full band. However, viewed from the perspective of efficiency and speaker design, only one coil does real work at once, and two separately operating (hence smaller) coils must be jammed into the available gap space.

Thus, the construction of Watkins '216, in addressing a specific back-EMF problem, does not employ two or more coils placed directly in parallel, and introduces two partial-duty coils in the gap. That is, in solving a problem of non-linearity of response due to back EMF at resonance, Watkins does not layer two coils directly in parallel as now claimed, and does not address overall magnet utilization, but merely corrects a non-uniformity of actuation in a narrow band, by resorting to two (apparently lesser capacity) coil circuits that each operate sometimes, and can be matched at their transition.

Applicant's attorney has further reviewed the other references noted by the Examiner. Of these, the Tanabe *et al.* '324 patent shows, in the embodiments of Figures 1-4, speakers having two voice coils. However, the two coils are located in two completely different magnet regions that also have different polarity. Tanabe *et al.* arrange that the coils have current flow in opposite senses, in order to produce additive driving forces in the same direction. Since the two coils of Tanabe *et al.* are separated, they are clearly not *layered* as recited in applicant's claims.

The '216 patent and the '324 patents each address different problems, and each employs a structure different from that claimed by applicant. Neither these, nor the other references teach or suggest the claimed invention, separately or together. For all of the foregoing reasons the rejections previously asserted against the independent claims have no application to the claims now presented, and the cited art thus does not affect the patentability of any of claims 1-22.

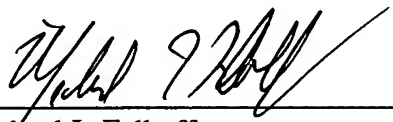
Application No: 09/439,416
Filing Date: November 13, 1999
Group Art Unit: 2743
Examiner: D. Harvey
Atty. Docket No: 102316-3

Accordingly, all claims are now allowable. Applicant's attorney therefore respectfully requests that the Examiner reconsider the application, reexamine the claims, and allow all claims at this time. If any other matters are found to require attention before allowance of the application, applicant's attorney requests the courtesy of a telephone call to discuss such matters so he may expeditiously address them. Formal drawings will be submitted in due course.

Respectfully submitted,

NUTTER, MCCLENNEN & FISH, LLP

Date: 25 January 2001



Michael I. Falkoff
Reg. No. 30,833
Attorney for Applicant

One International Place
Boston, MA 02110-2699
Tel: (617) 439-2879
Fax: (617) 310-9879